

Deaths from Pesticide Poisoning in England and Wales: 1945–1989

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- 1 Data on deaths from pesticide poisoning occurring in England and Wales between 1945 and 1989 (no data are available for 1954) have been collated; pesticides were responsible for only 1012 (1.1%) of the 87,385 deaths from poisoning (excluding those due to carbon monoxide) occurring over this 44 year period. At least 73% of all pesticide fatalities were due to suicide and overall there was a predominance of males (male:female ratio 2.4:1). No deaths from pesticide poisoning in children under 10 years have been reported since 1974 although almost 50% of suspected pesticide poisoning incidents involve this age group.
- 2 Herbicides were responsible for 787 (78%) fatal poisonings, 110 (11%) were caused by insecticides, 69 (6.8%) by rodenticides, 30 (3.0%) by wood preservatives and 16 (1.6%) by other pesticides.
- 3 The herbicide, paraquat, was responsible for 570 of 1012 (56%) deaths and, although there has been a progressive decline in the annual number of deaths from paraquat poisoning since 1982, paraquat remains the most common cause of fatal pesticide poisoning in England and Wales.
- 4 Sodium chlorate caused 113 (11.2%) deaths, most of these fatalities occurring between 1965 and 1983; only one death has been recorded since 1984. The phenoxyacetate herbicides resulted in 50 deaths; 2,4-D was implicated most commonly. Sixty-eight deaths were due to organophosphorus insecticides; demeton-S-methyl, malathion and mevinphos were involved most frequently. Only eight deaths resulted from organochlorine insecticides and two of these also involved an organophosphorus insecticide.
- 5 Although pesticide poisoning is an uncommon cause of admission to hospital in England and Wales, the mortality remains high at least in adult cases due to the suicidal ingestion of paraquat.

Introduction

Acute pesticide poisoning is an important cause of world-wide morbidity and mortality.¹ It has been estimated that there are three million severe cases of acute pesticide poisoning each year with some 220,000 deaths.^{1,2} Ninety-five per cent of fatal pesticide poisonings occur in developing countries, where 25 million episodes of intoxication occur annually among agricultural workers alone.^{3,4} Although pesticide poisoning is an uncommon cause of admission to hospitals in England and Wales,⁵ Scotland⁶ and North America,⁷ mortality among adult cases of pesticide poisoning admitted to hospital was 12% in England and Wales⁵ and 19% in Scotland.⁶ This compares unfavourably with reported mortality rates of less than 1% among all poisoned patients admitted to hospitals in England,^{8,9} Northern Ireland¹⁰ and Norway.¹¹ Pesticides were involved in only 18 (2.9%) of the 612

fatal cases of poisoning reported to the American Association of Poison Control Centers (AAPCC) National Data Collection System in 1990¹² and in 18 (2.4%) of the 764 fatal cases reported in 1991.⁷

It has been established that deaths occurring in English hospitals represent only a small proportion of all deaths from poisoning⁸ and therefore the examination of mortality data based on returns made by her Majesty's Coroners will give a more accurate estimate of the total number of pesticide related deaths which occur and allow identification of the pesticides most frequently implicated.

Methods

In England and Wales, data on deaths from acute poisoning are collected by the Office of Population Censuses and Surveys (OPCS) based on returns from Coroners. We have analysed data on fatalities due to pesticide poisoning occurring in England and Wales between 1945 and 1989, though no data are available for 1954. Pesticides include substances

and organisms used as herbicides, insecticides, fungicides, rodenticides, molluscicides, plant growth regulators and protective agents for buildings and building materials. The following chemicals were excluded from our analysis, unless specifically identified as a pesticide: arsenic, boric acid or borax, copper sulphate, cyanide, nicotine and strychnine. Pesticides which contain both paraquat and diquat, e.g. Weedol, were classified as paraquat. The analysis of age distribution is limited to the period 1974 to 1989 as the ages of all victims were not collected prior to 1974.

Results

Excluding fatalities from carbon monoxide poisoning there were 87,385 deaths from poisoning recorded in England and Wales between 1945 and 1989 of which 1012 involved pesticides. Between 1945 and 1970, pesticides accounted for less than 1% of all deaths from poisoning though, following the introduction of paraquat, this proportion increased during the 1970s reaching 2.9% in 1981, subsequently declining to 0.9% in 1989 in line with the falling number of paraquat deaths.

Between 1945 and 1967, 73% of pesticide related deaths were classified as suicides by the Coroners and 27% as accidents and homicides. Following the inclusion in 1968 of an additional classification of deaths, 'undetermined whether accidentally or purposely inflicted', 68% of pesticide related deaths were classed subsequently as suicides, 13% as accidents and 19% were of undetermined intent. Seven hundred and seventeen of 1012 victims of fatal pesticide poisoning were male (male:female ratio 2.4:1) and less than 10% of the victims were under 25 years of age (Figure 1); no deaths from

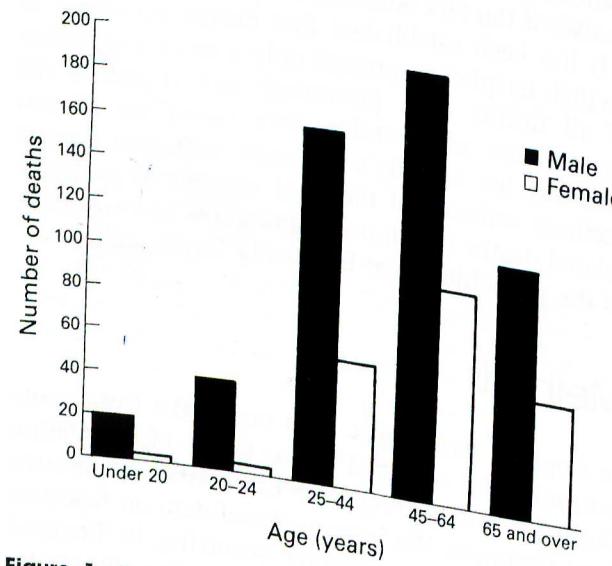


Figure 1 Deaths from pesticide poisoning in England and Wales between 1974 and 1989: Age and sex distribution.

pesticide poisoning in children under 10 years have been reported since 1974, the first year in which a full age analysis was available.

Seven hundred and eighty seven of 1012 (77.7%) fatal pesticide poisonings were caused by herbicides, 110 (10.9%) by insecticides, 69 (6.8%) by rodenticides, 30 (3.0%) by wood preservatives and 16 (1.6%) by molluscicides, fungicides and miscellaneous pesticides (Table 1). The herbicide paraquat, was implicated in 570 (56.3%) of the 1012 deaths from pesticide poisoning recorded between 1945 and 1989, though the first paraquat related death did not occur until 1966, four years after its introduction as a broad-spectrum herbicide. Paraquat rapidly became the most common cause of fatal pesticide poisoning in England and Wales with 55 deaths recorded in 1981 (Figure 2). Although the number of paraquat related deaths fell subsequently, paraquat remains the most common cause of fatal pesticide poisoning and was implicated in

Table 1 Deaths from pesticide poisoning in England and Wales 1945-1989

Pesticide	Number (% of all pesticide deaths)
Herbicides	
Paraquat	787 (77.7%)
Sodium chlorate	570 (56.3%)
Phenoxyacetates	113 (11.2%)
Other/Unknown	50 (4.9%)
Insecticides	54 (5.3%)
Organophosphorus	110 (10.9%)
Organochlorine	68 (6.7%)
Other/Unknown	8 (0.8%)
Rodenticides	34 (3.4%)
Phosphorus	69 (6.8%)
Other/Unknown	51 (5.0%)
Wood Preservatives	18 (1.8%)
Creosote	30 (3.0%)
Other	27 (2.7%)
Molluscicides	3 (0.3%)
Fungicides	7 (0.7%)
Miscellaneous	6 (0.6%)
Total	3 (0.3%)
	1012 (100%)

Table 2 Deaths from phenoxyacetate herbicide (Ph.H) poisoning

Pesticide	Number (% of all Ph.H deaths)
2,4-D, Mecoprop	18 (36%)
2,4-D	16 (32%)
2,4-D, Dicamba, Ioxynil	6 (12%)
2,4-D, Dicamba, Mecoprop	2 (4%)
2,4-D, 2,4-DP	1 (2%)
2,4-D, 2,4,5-T	1 (2%)
2,4-D Dicamba	1 (2%)
2,4-D, Dichlorprop	1 (2%)
Dicamba, MCPA, Ioxynil	1 (2%)
MCPA	1 (2%)
Unknown	1 (2%)
Total	50 (100%)

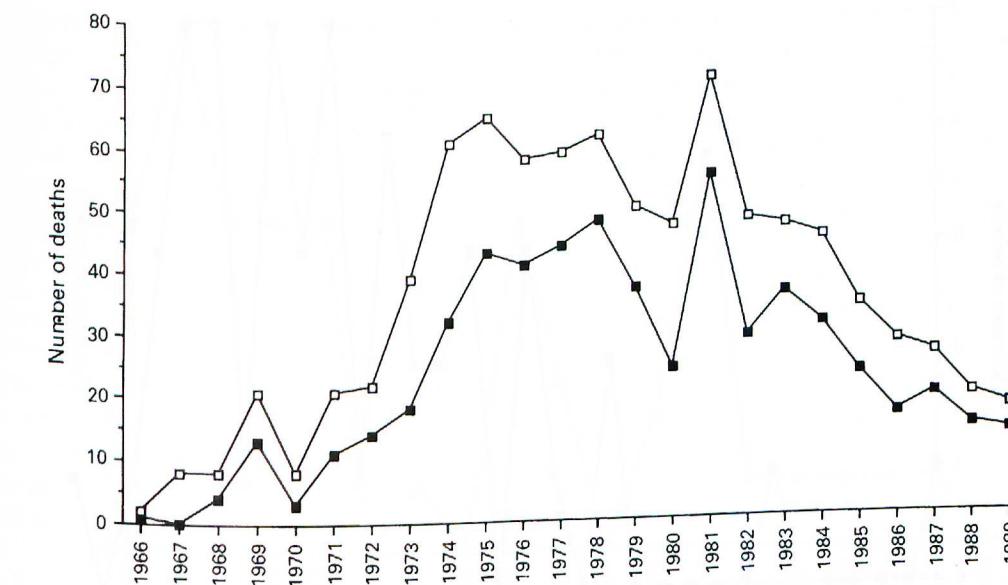


Figure 2 Deaths from pesticide poisoning (—□—) and paraquat poisoning (■) in England and Wales between 1966 and 1989.

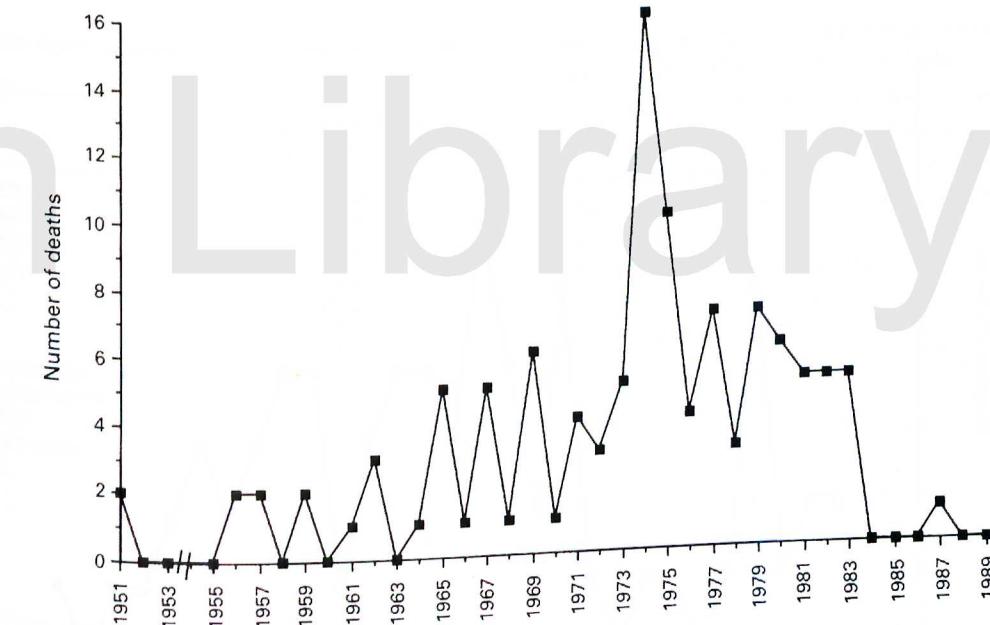


Figure 3 Deaths from sodium chlorate poisoning in England and Wales between 1951 and 1989.

76.5% of pesticide deaths in 1989. Overall, sodium chlorate was the cause of 113 (11.2%) deaths between 1951-1989; 88% of these deaths occurred between 1965 and 1983 (Figure 3) and only one death was recorded in the subsequent six years. The phenoxyacetate herbicides were implicated in 50 deaths between 1945 and 1989 (Table 2); a maximum of five deaths being recorded annually (Figure 4). Forty six fatalities involved 2,4-D (2,4-dichlorophenoxyacetic acid); 2,4-D was the sole agent implicated in 16 deaths and 18 deaths involved both 2,4-D and mecoprop. Overall only 68

deaths were due to organophosphorus insecticides, most commonly demeton-S-methyl (19), malathion (11) and mevinphos (7) (Table 3). Parathion was implicated in only three deaths during the period studied. The maximum number of organophosphorus insecticide related deaths recorded in one year was six, in 1974 (Figure 5). Only eight deaths between 1945 and 1989 involved the organochlorine insecticides, DDT was implicated in five cases, two of which also involved the organophosphorus insecticide, malathion (Table 4). In the late 1940s the phosphorus rodenticides were the most

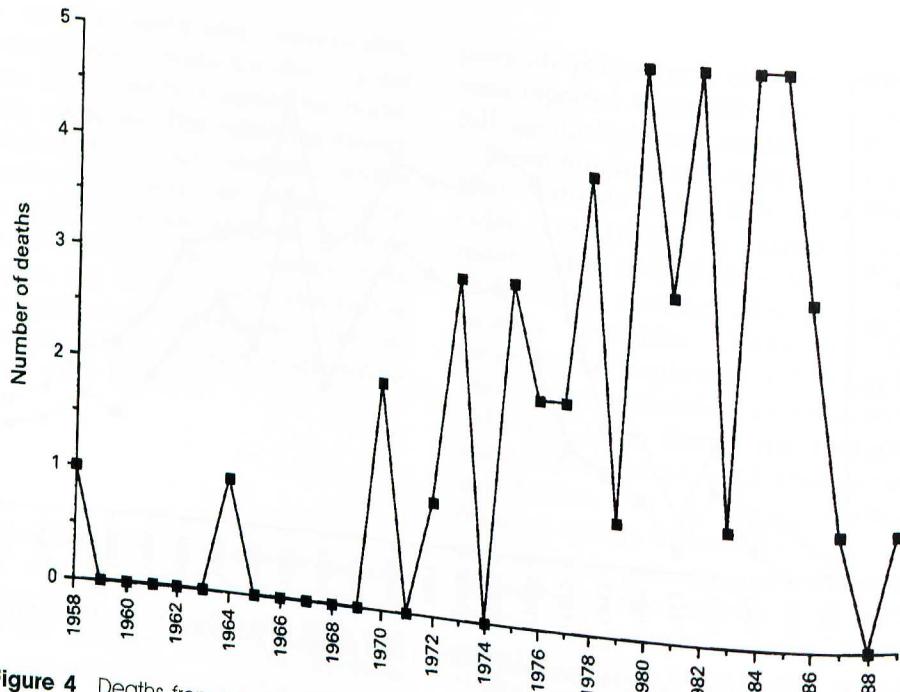


Figure 4 Deaths from phenoxyacetate herbicide poisoning in England and Wales between 1958 and 1989.

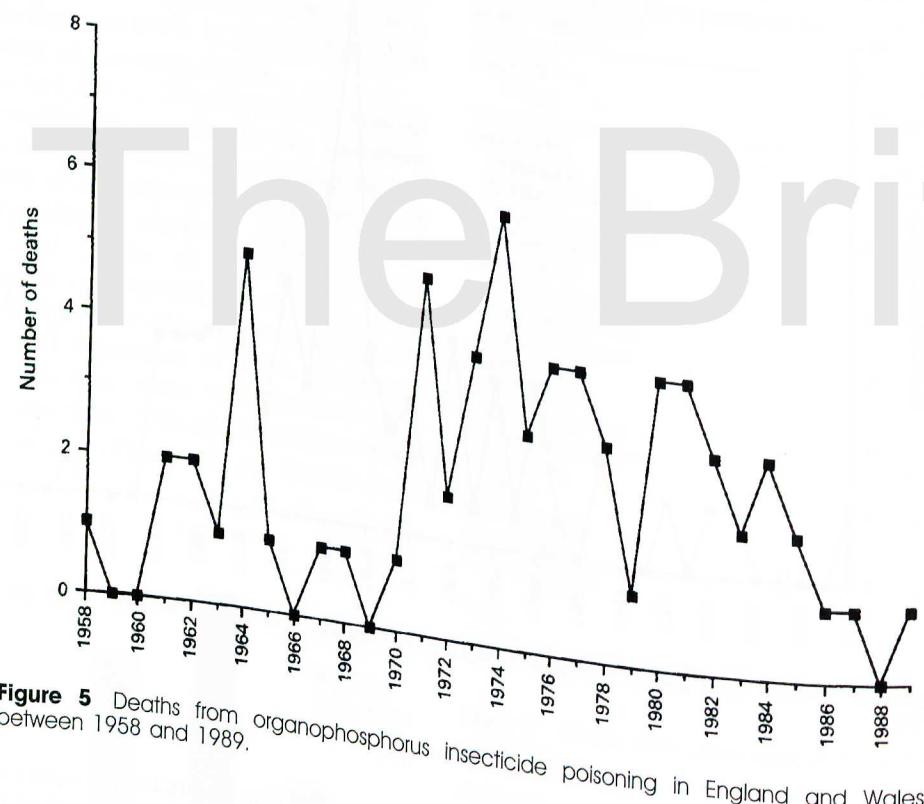


Figure 5 Deaths from organophosphorus insecticide poisoning in England and Wales between 1958 and 1989.

common cause of fatal pesticide poisoning in England and Wales, but no deaths from these pesticides have been recorded since 1963 (Figure 6).

Discussion

Pesticides are involved in only 3–5% of suspected poisoning incidents in Scotland¹³ and Wales¹⁴ and are an uncommon cause of fatal poisoning in

England and Wales. Overall, only 1% of fatal cases of poisoning recorded between 1945 and 1989 were caused by pesticides. Almost three quarters of deaths from pesticide poisoning were suicides, although caution is necessary in the interpretation of intent. Deaths are now classified by Coroners as an accident, suicide, homicide or undetermined (i.e. an 'open' verdict). Before a Coroner returns a verdict of suicide or issues a death certificate implying suicide, the Coroner must be satisfied that

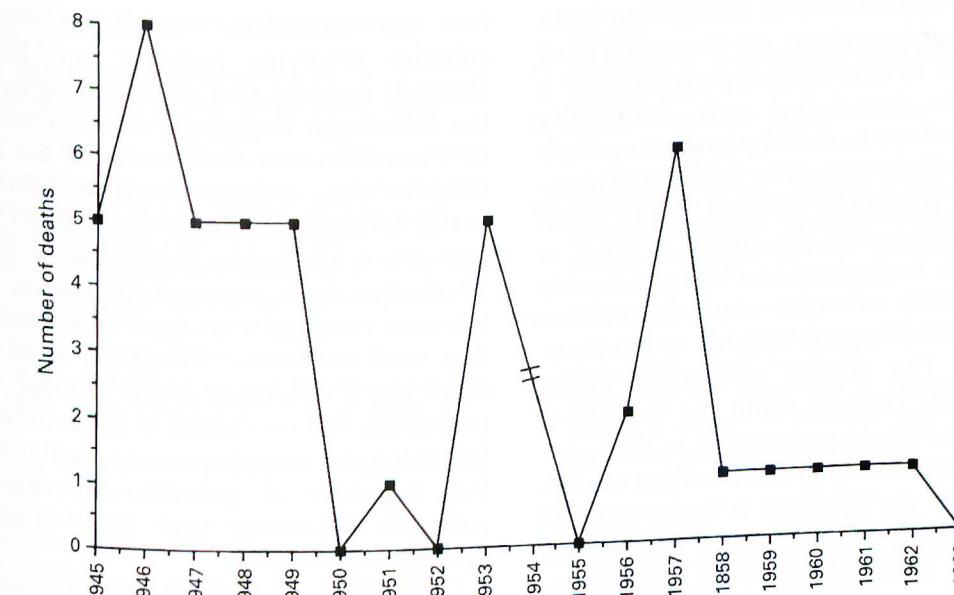


Figure 6 Deaths from phosphorus rodenticide poisoning in England and Wales between 1945 and 1963.

Table 3 Deaths from organophosphorus insecticide (OP) poisoning

Pesticide	Number (% of all OP deaths)
Demeton-S-methyl	19 (27.9)
Demeton-O-methyl	1 (1.5)
Demeton methyl	1 (1.5)
Malathion	11 (16.2)
Mevinphos	7 (10.3)
Parathion	3 (4.4)
Dimethoate	3 (4.4)
Heptenophate, weedkiller	1 (1.5)
Pirimiphos, permethrin	1 (1.5)
Formothion-methyl	2 (2.9)
Dichlorvos	1 (1.5)
Diazinon	1 (1.5)
Azinphos-ethyl	1 (1.5)
Unspecified	1 (1.5)
Total	68 (100)

Table 4 Deaths from organochlorine insecticide (OC) poisoning

Pesticide	Number (% of all OC deaths)
DDT	3 (37.5)
DDT, malathion	2 (25.0)
Dieldrin	1 (12.5)
Lindane	1 (12.5)
Lindane, malathion, barbiturate, kerosene	1 (12.5)
Total	8 (100)

the action which led to the deceased's death was self-initiated and that the deceased intended that the act should have fatal consequences. If there is

any 'reasonable doubt' that these criteria are fulfilled, the Coroner is not justified in returning or implying suicidal death.¹⁵ As a result, it has been suggested that a high proportion of undetermined deaths are also likely to be due to suicide.^{15,16}

No deaths from pesticide poisoning in children under 10 years have been recorded since 1974 although approximately 50% of suspected poisoning incidents involve this age group.^{1,7,13} This reflects the clinical reality that although the potential toxicity of pesticides may be high, the hazard presented to children is low because the dose ingested is small. Only 23% of children who attended an accident and emergency department in the UK following a suspected pesticide poisoning incident were admitted to hospital and the majority (95%) were discharged in less than 48 hours (to be published). Eighty-five per cent of children admitted to hospital in Finland with suspected pesticide poisoning were asymptomatic or were judged to have symptoms unrelated to a pesticide exposure.¹⁷

The male:female ratio of 2.4:1 is in striking contrast to that generally pertaining in developed countries where females outnumber males among hospital attendances and admissions following self poisoning.^{18–21} However, in the Republic of Ireland, England and Wales and Denmark the male suicide rates exceed female rates.¹⁵ A similar male predominance was reported among cases of pesticide poisoning admitted to hospitals in Finland¹⁷ and the Edinburgh Regional Poisoning Treatment Centre.⁶ The predominance of men was most marked in patients aged 20–40 years admitted to the Edinburgh Centre and in the 25–44 years age group in the present study. This may reflect the occupa-

tional availability of pesticides in this age group. In Sri Lanka, where agrochemicals are the agents most frequently ingested in cases of self poisoning,²²⁻²⁴ a study of 97 cases found that easy availability together with a lack of knowledge regarding their lethality were the main causative factors determining the choice of poisoning agents.²² While availability may have influenced the choice of agent in the cases of suicide in England and Wales it is very unlikely that, at least in recent years, the victims were unaware of the potential lethality of the pesticides concerned. The present climate of media attention and public concern about the toxicity of pesticides together with improvements in the training of applicators and the adequate labelling of such products mean that the opposite is more likely to be the case. On the contrary, media coverage of individual cases of paraquat poisoning, often sensationalised, may have influenced others to use paraquat as a means of suicide.^{25,26}

Paraquat has been responsible for more deaths than all other pesticides combined although there has been a progressive decline in the annual number of deaths from parquat poisoning since 1982. The rise in paraquat fatalities which occurred from the late 1960s to the early 1970s was due to an increase in the use of paraquat for suicide.²⁶ In the UK the Poisons Act of 1972 and the Poisons Rules of 1982 restrict the sale of concentrated paraquat formulations to 'persons engaged in the trade or business of agriculture, horticulture or forestry'. These restrictions do not appear to have

had any immediate impact on the number of suicides involving paraquat and Proudfoot and Dougall⁶ reported that six of ten paraquat deaths at the Edinburgh Regional Poisons Treatment Centre between 1981 and 1986 involved the 20% concentrate and none of those who died had right of access to this formulation. There was a direct link between occupation and access to paraquat in only 13 of the 79 deaths from paraquat poisoning in Scotland between 1975 and 1984 for which details of occupation were available.²⁶ Fitzgerald *et al.*²⁷ found that there was a reduction in the number of accidental poisonings but no change in the number of suicides following the introduction of similar legislation in the Republic of Ireland and that intentional paraquat poisoning was most common among agricultural workers.

Only 10.9% of pesticide deaths were caused by insecticides which is in keeping with the report that only 12% of patients older than 10 years admitted to hospital in England and Wales with suspected pesticide poisoning had ingested or inhaled an organophosphorus, organochlorine or carbamate insecticide.⁵ This contrasts with developing countries where insecticides are a major cause of hospital admission^{22,23,28} and mortality.^{23,29}

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Acknowledgements

This work was supported by a research grant from the Health and Safety Executive.